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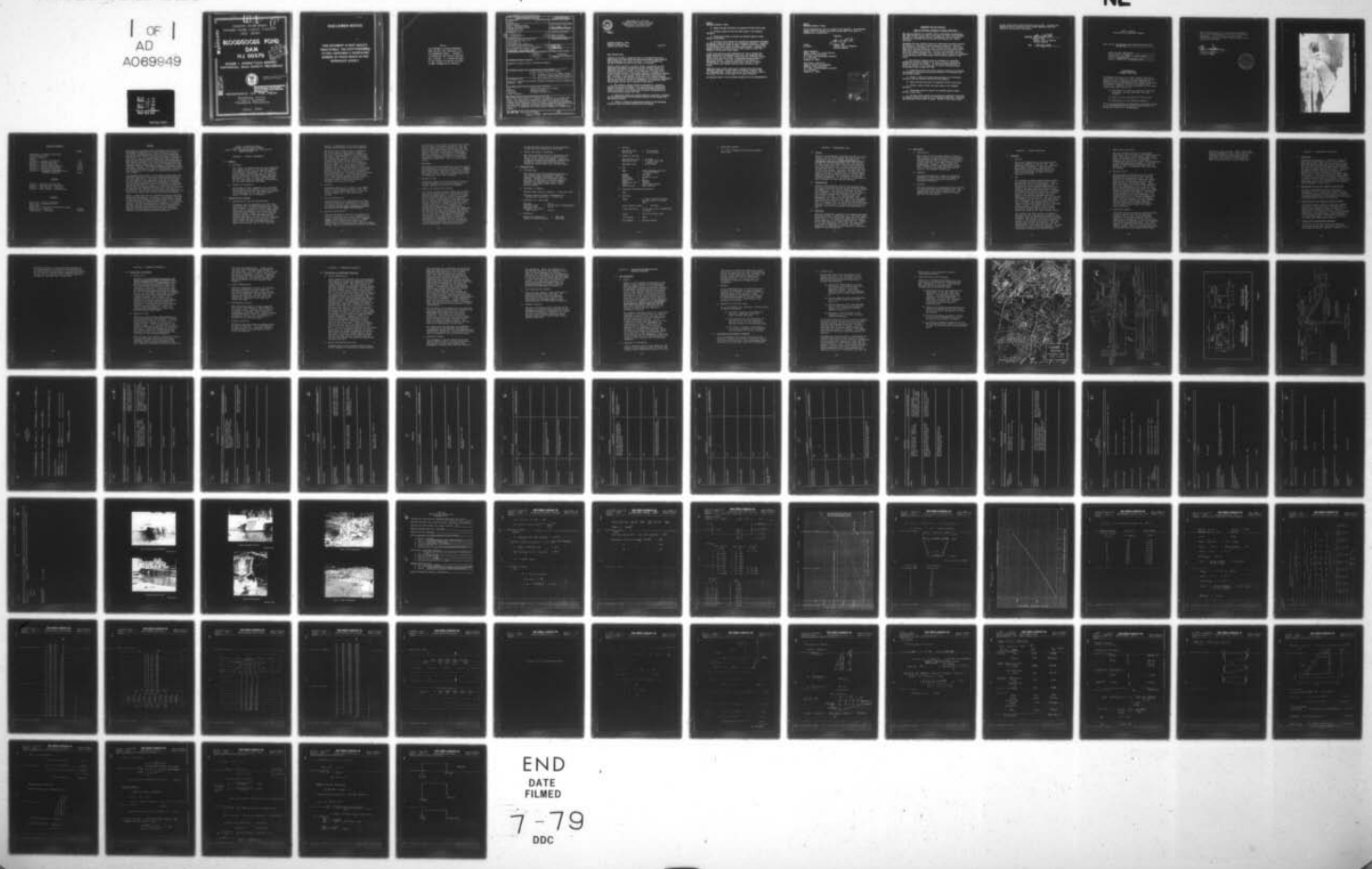

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RARITAN RIVER BASIN
RAHWAY RIVER, UNION COUNTY
NEW JERSEY

BLOODGOODS POND DAM
NJ 00370

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

March, 1979

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18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service, Springfield, Virginia, 22151.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dams	National Dam Inspection Act Report
Spillways	Structural Analysis
Flood gate	Bloodgoods Pond Dam, N.J.
Visual Inspection	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-D

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

4 JUN 1979

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Bloodgoods Pond Dam in Union County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Bloodgoods Pond Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in poor overall condition. The spillway capacity is considered inadequate since 67 percent of the Spillway Design Flood (SDF) would overtop the dam. (The SDF, in this instance, is one half of the Probable Maximum Flood.) To insure the continued functioning of the dam and its impoundment, the following remedial actions are recommended to be undertaken within twelve months from the date of approval of this report:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980.

b. Engineering studies and analysis should be initiated to determine the foundation conditions and structural stability of the original slab and buttress spillway.

c. Repair or replace the deteriorated concrete in the flood-gate structure, slab and buttress spillway and left wingwall.

d. Repair and make functional the inoperable 30-inch sluice gate.

e. Provide a method of safe and rapid access to the floodgate structure.

f. Investigate methods to improve the drawdown capacity during periods of high flows.

g. The owner should upgrade the operating and maintenance procedures by issuing a manual and check list for recommended procedures. Inspection and maintenance visits should be logged. Records of pond levels should be kept during routine visits and during severe storms. An annual site inspection should be conducted using a visual inspection check list similar to the one used in this report.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Matthew Rinaldo of the Twelfth District. Under the provisions of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation

NAPEN-D
Honorable Brendan T. Byrne

of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

James G. Ton

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

Copies furnished:
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Division of Water Resources
N. J. Dept. of Environmental Protection
P. O. Box CN029
Trenton, NJ 08625

John O'Dowd, Acting Chief
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Division of Water Resources
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P. O. Box CN029
Trenton, NJ 08625

BLOODGOODS POND DAM (NJ00370)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 1 December 1978 by Louis Berger and Associates, Inc. under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Bloodgoods Pond Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in poor overall condition. The spillway capacity is considered inadequate since 67 percent of the Spillway Design Flood (SDF) would overtop the dam. (The SDF, in this instance, is one half of the Probable Maximum Flood.) To insure the continued functioning of the dam and its impoundment, the following remedial actions are recommended to be undertaken within twelve months from the date of approval of this report:

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e. Provide a method of safe and rapid access to the floodgate structure.

f. Investigate methods to improve the drawdown capacity during periods of high flows.

g. The owner should upgrade the operating and maintenance procedures by issuing a manual and check list for recommended procedures. Inspection and maintenance visits should be logged. Records of pond levels should

be kept during routine visits and during severe storms. An annual site inspection should be conducted using a visual inspection check list similar to the one used in this report.

APPROVED: James G. Ton

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 30 May 1979

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam Bloodgoods Pond Dam Fed ID# NJ 00370
NJ ID# 619

State Located New Jersey
County Located Union
Coordinates Lat. 4037.7 - Long. 7418.0
Stream Rahway River
Date of Inspection 1 December 1978

ASSESSMENT OF GENERAL CONDITIONS

Bloodgoods Pond Dam is in a poor overall condition. Uncertainty with respect to the configuration of the original slab and buttress spillway necessitates additional site investigations and engineering studies to ascertain continued stability at design flood elevations. Remedial actions recommended to be undertaken in the near future are:

(1) Replacement of existing concrete flood-gate structure, original spillway, and left wingwall;

(2) Repair of the inoperable 30" sluice gate;

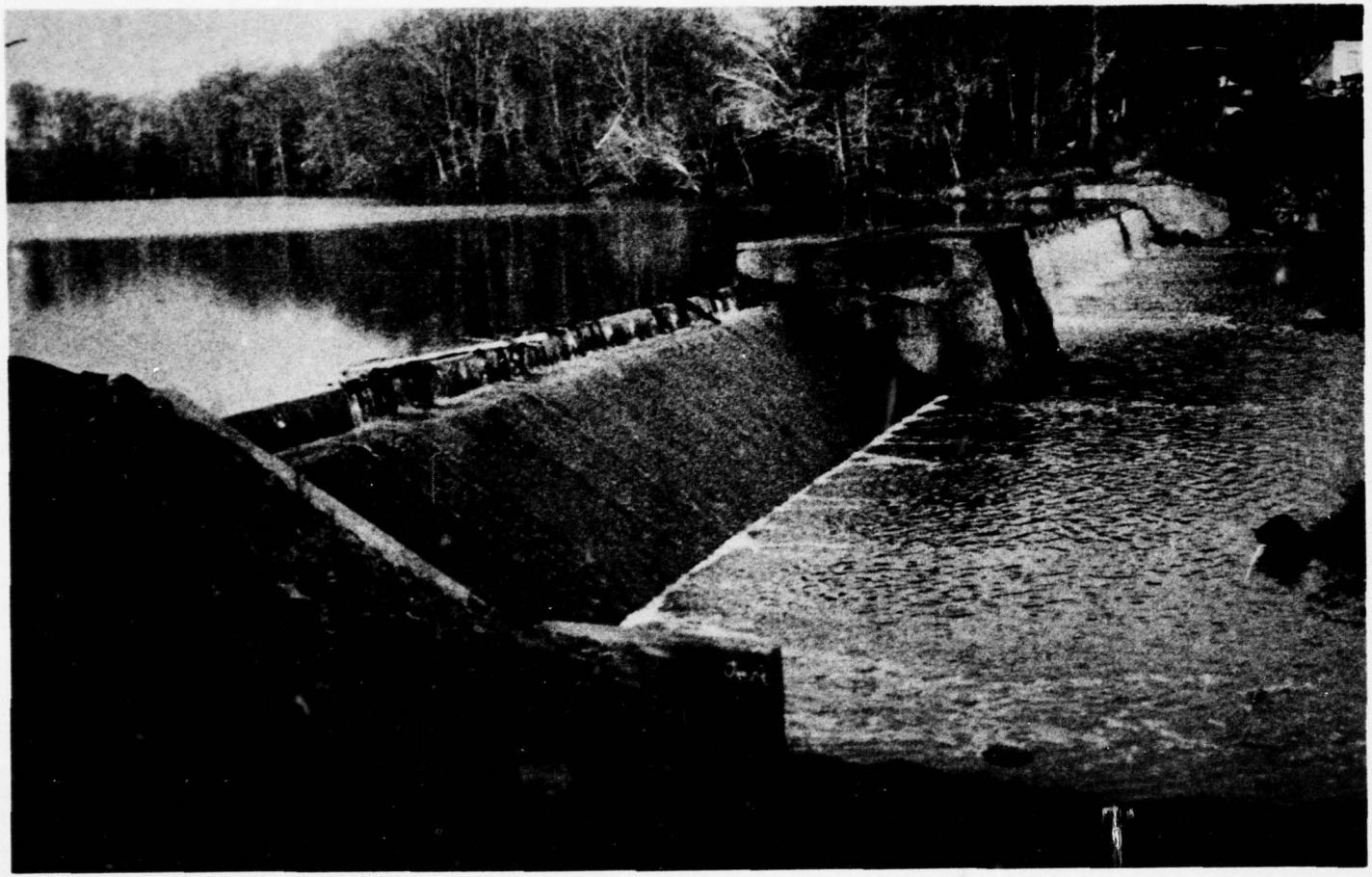
(3) Improvement of the drawdown capacity.

In view of the downstream conditions and height of dam, it is recommended that the hazard classification be downgraded from high to significant.

The spillway capacity of the dam can accommodate 66% of the spillway design flood and is therefore inadequate. In conjunction with the other engineering studies, further hydraulic/hydrologic should be undertaken.

F. Keith Jolls P.E.
Project Manager

STATE OF KENTUCKY
F. KEITH
JOLLS
5432
REGISTERED
PROFESSIONAL ENGINEER



OVERVIEW OF BLOODGOOD'S POND DAM

DECEMBER, 1978

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
NAME OF DAM: BLOODGOODS POND DAM FED #NJ00370
AND NJ ID #619

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

This report is authorized by the Dam Inspection Act, Public Law 92-367, and has been prepared in accordance with Contract FPM-36 between Louis Berger & Associates, Inc. and the State of New Jersey and its Department of Environmental Protection, Divison of Water Resources. The State, in turn, is under agreement with the U.S. Army Corps of Engineers, Philadelphia to have this inspection performed.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the structural and hydraulic condition of the Bloodgoods Pond Dam and appurtenant structures, and to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

Bloodgoods Pond is impounded by an 450' dam containing two spillways separated by a flood gate structure. The dam's configuration (from east to west) consists of (1) 50'± short earth embankment and abutment section covered with heavy, mortared riprap; (2) a 158'± long old concrete section of Amberson-type slab and buttress spillway; (3) a 28' concrete and timber flood gate structure with five chambers, one of which contains a sluice gate; (4) a newer (1971) 75' long ogee-type earth and sheet core spillway; and (5) the remaining

section of embankment (with heavy mortared riprap) which extends to the west abutment.

The flood gate structure has an inoperable 30" sluice gate in the central chamber. The four remaining chambers are sealed with stop logs. The westerly 75' long spillway was constructed in 1972 to replace a section of breached embankment and contains an interlocking steel sheet piling cutoff wall which is capped by a 4' x 2.75' reinforced concrete beam. A 12 inch thick reinforced concrete slab forms the backslope of the spillway and is underlain with a 6 inch thick crushed rock bed. The 158' slab and buttress spillway is part of the original structure and is supported by a 22' wide concrete footing of unknown thickness. Both spillways have their crest height augmented by the addition of 15 inch high flashboards affixed in a permanent position by reinforcing bars embedded in the concrete crest.

b. Location

Bloodgoods Pond Dam is located on the Rahway River in Clark Township, Union County, New Jersey; approximately 1800 feet to the east of Interchange 135 on the Garden State Parkway.

c. Size Classification

Bloodgoods Pond Dam is approximately 14 feet high and impounds an estimated 312 acre feet of water at maximum pool elevation. Based on the Guidelines for Safety Inspection of Dams, this dam is in the small size category.

d. Hazard Classification

Although Bloodgoods Pond Dam is located in a densely populated area, it is recommended the hazard classification be downgraded to significant as the dam and river lie in a deeply incised river valley which widens into a marsh above the Jackson Pond Dam, 7000 feet downstream. Most of the downstream adjacent residences

are located on the bluffs overlooking the valley and are above flood water elevation. The dam failed during the Doria hurricane of 1971 and most of the ensuing flood was contained by the Jackson Pond Dam with only minor downstream damage. However, a dam failure at Bloodgoods Pond could trigger a collapse of the Jackson Pond Dam and endanger the Valley Road bridge immediately downstream. This is a busy urban artery.

e. Ownership

Bloodgoods Pond Dam is owned by the Union County Park Commission, Elizabeth, New Jersey. However, monitoring of the dam is performed by the Rahway Water Department. Moreover, repairs to the dam following the 1971 failure were performed under the auspices of the City of Rahway.

f. Purpose of Dam

Bloodgoods Pond is utilized jointly for recreational purposes and to provide additional storage capacity for the City of Rahway.

g. Design and Construction History

Particulars of the original design and construction of Bloodgoods Pond Dam are uncertain and apparently undocumented. A 1936 W.P.A. stream survey indicated that the dam was constructed at an earlier time and built in conjunction with a factory; reportedly to have been located further downstream. Following the 1971 Doria failure, the City of Rahway retained Elson T. Killam Associates, Inc. to redesign and refurbish the demolished and deteriorating portions of the dam. Their design was completed and the work let out to bidders in the spring of 1972 and was apparently accomplished by the end of that year. The repairs included the construction of an additional 75' spillway, the placing of mortared riprap along both embankments, refurbishing of the interior of the flood gate structure and the installation of new flash boards along the entire length of both spillways. The 158 foot portion

of old spillway and exterior of the floodgate section were not repaired at this time.

h. Normal Operational Procedures

The only regulating device at Bloodgoods Pond Dam is the 30" sluice gate located in the center of the flood gate housing. There are no specific operating procedures governing the regulation of this gate which can only be reached by walking along the spillway crest.

1.3 PERTINENT DATA

a. Drainage Area

The drainage area for Bloodgoods Pond Dam is 39.3 square miles consisting of heavily populated suburban development and urban centers. Included in the drainage area are the towns of Westfield, Cranford, Roselle, Roselle Park, Springfield, Union, Summit, Millburn, Maplewood, South Orange, and a part of Linden.

b. Discharge at Damsite

Maximum known flood at damsite - 5,200 cfs (1973)

Spillway capacity without flashboards (at maximum pool elevation) - 13,550 cfs

c. Elevation (ft. above MSL)

Top Dam	-	+41.2
Recreation pool	-	+35.75 (top of flashboards)
Spillway crest	-	+34.50
Streambed at center-line of dam	-	+27.5±

d. Reservoir

Length of maximum pool	-	4600 feet
Length of recreation pool	-	1000 feet

e. Storage

Recreation pool	-	75 acre-feet
Top of dam	-	312 acre-feet

f. Reservoir Surface

Top dam (Max. pool	-	44 acres
Recreation pool	-	30 acres (from App. Permit 619)
Spillway crest	-	26.75 acres

g. Dam

Type	-	Earth abutments and concrete spillways
Length	-	450 feet
Height	-	14 feet
Top Width	-	Varies (3 to 6')
Side Slopes	-	2:1
Zoning	-	Unknown
Impervious Core	-	Unknown
Cutoff	-	Steel sheet piling
Grout curtain	-	None recorded

h. Diversion and Regulating Tunnel

None

i. Spillway

Types	-	1) 158' concrete slab and buttress and 2) 75' ogee type
Total length of weir	-	233 feet
Crest elevation	-	+35.75 with 1.25' flashboards in place.
Gates	-	One 30" Ø sluice gate
U/S Channel	-	None
D/S Channel	-	Natural Stream

j. Regulating Outlets

4 - 3'-8" floodgate sections with timber stop logs.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

There is no information available pertaining to the original design of Bloodgoods Pond Dam except that contained in the 1972 "Report Upon Repair to Bloodgoods Pond Dam and Jackson Pond Dam" prepared by Elson T. Killam Associates, Inc. In addition to this report there were three drawings prepared by Killam depicting plan, sections and details of the existing dam as well as their proposed modifications and repairs. Pertinent data received from the Division of Water Resources included copies of Killam's hydraulic calculations, the repair permit application, design specifications, and the repair drawings themselves. No information concerning foundation materials or the details of construction were available for the original spillway.

2.2 CONSTRUCTION

Killam's 1972 drawings indicate the original construction conditions as well as the designed repairs and appear to be an accurate depiction of the existing conditions. The slab and buttress spillway, left abutment, and flood-gate structure are part of the original dam which is thought to have been built prior to 1936. The right abutment and embankment, all riprap, the flashboards, ogee spillway and the new gate and stop logs in the floodgate structure are all part of the repairs performed in 1972. It appears that no repairs of the deteriorated concrete in the face of the gate structure, the old spillway, and the left abutment were performed in 1972.

2.3 OPERATION

From the information gathered, no standard operating procedures exist at Bloodgoods Dam. Although legally owned by the Union County Park Commission, its monitoring and care is presently handled by the Rahway Water Department in an unofficial capacity. Personnel of that department report that the sluice gate is presently inoperative. However, the overall operation, as observed during a period of low flow, appears to be satisfactory.

2.4 EVALUATION

a. Availability

While none of the original design, construction drawings or specifications were available, the engineering data available on the Killam drawings was utilized to perform an evaluation of the stability of the dam structure and embankments. However, nothing definite is known regarding the older spillway's foundation, so much of the analysis contained in Section 6 is somewhat conjectural.

b. Adequacy

The data available for review is considered inadequate to perform a valid assessment of the dam's existing condition and overall structural stability.

c. Validity

The field inspection substantitates the accuracy of the engineering data available within the limitations of the visual observations. The assumptions made during the previous repair work are not challenged.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

The visual inspections of the dam were performed on December 1 and 28, 1978. The inspection team found the dam in a generally poor overall condition. The concrete deterioration and inaccessibility of the flood gate structure and gate control as well as the presence of debris at both spillways was noted.

b. Dam

The vertical alignment appears quite regular as indicated by the uniform depth of flow passing over each of the spillways. Both of the recently renovated embankments were observed to be in a stable condition and are covered with heavy mortared riprap on both upstream and downstream sides (for a distance of 30 feet back from the spillway wingwalls). However, the riprap is scoured out at the toes of the spillway abutment wingwalls, especially on the south end. The new spillway and wingwall to the right of the gate structure also appear to be in satisfactory condition. However, the chamber walls of the concrete flood-gate housing are in an advanced state of decay. Extensive spalling and deterioration were noted on all surfaces as well as advanced deterioration of the downstream edges of the inner chamber walls.

The original 158 foot section of concrete spillway and the left abutting wingwall also exhibited signs of advanced deterioration and cracking. The wingwall concrete is extensively eroded at the base and the reinforcement is exposed and corroded (see photos). The downstream edges of the top apron slab and the buttress wall are cracked and spalled. A close inspection of this area was prevented by the continuous discharge over the spillway.

c. Appurtenant Structures

The only operable facility at Bloodgoods Pond Dam is the five-celled flood-gate structure whose inner walls, sluice gate, timber stop logs, and guides were all refurbished in 1972. However, the sluice gate is reportedly inoperable at the present time. The flashboards on both spillways were replaced in 1972 and appear in good condition although they are sealed in and it is doubtful that they could be removed.

d. Reservoir Area

The reservoir is situated in a low valley between the Garden State Parkway and the Winfield Park residential area. The left side of the valley rises relatively steeply and much of the upstream portion of the pond is heavily silted and swampy. Heavy brush and trees are growing on the banks and the area immediately to the right of the dam is raised substantially above the flood plain by extensive man-made fills with rather steep riprap protected slopes. The channel is fairly narrow at the dam with 20' high slopes adjoining the right embankment. An office parking lot is situated immediately upstream from the end of the dam embankment. The area between the right abutment and the Garden State Parkway contains several industrial and office buildings, all of which are well above the normal flood elevation.

e. Downstream Channel

The grade school and private residences downstream of the dam are for the most part, situated some 40 feet above the channel flowline. A few homes located along the Rahway River Parkway are 10 to 12 feet above the stream as it meanders around the southeast side of the Winfield peninsula. The clear channel is generally 40 to 50 feet wide and deeply incised. There is considerable mature tree growth along the numerous bifurcated

downstream water courses. About 4,000 feet down the meandering river valley again widens, gradually becoming a marsh some distance upstream of the Jackson Pond Dam (which is positioned just north of Valley Road and about 0.7 mile due east of the study dam).

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

Operational procedures are limited in scope and are generally performed by the City of Rahway Water Department. Their work is limited to gate and stop log adjustment and general maintenance, with the Union County Park Commission monitoring the bank and shore line erosion control, policing and debris removal from the reservoir. During periods of low flow, the Water Department releases flow from the reservoir by opening the flood gate. In the event additional water supply is required or the reservoir must be dewatered, a tripod lifting device is utilized to remove the stop logs. Due to the inaccessibility, neither of these procedures can be effectively administered during periods of heavy flow.

4.2 MAINTENANCE OF DAM AND OPERATING FACILITIES

The Water Department concerns itself with maintenance of the sluice gate, stop-logs and flashboards on an "as-required" basis. Neither the Water Department or Park Commission have any established procedures or schedules for maintenance of the remainder of the dam structure.

4.3 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

No warning system exists for this dam although personnel of the City Water Department make a daily visual inspection while collecting water samples for laboratory analysis. Obvious deficiencies are reported to the City Engineering Department, although there is some ambiquity as to the extent of what rehabilitation measures the Water Department is willing to undertake in its unofficial maintenance capacity.

4.4 EVALUATION OF OPERATIONAL ADEQUACY

In view of the limited extent of regulatory facilities at the dam, the present procedures are deemed marginally adequate. However, in the

interest of safety, a more definitive delineation of responsibility is believed to be necessary for the safe operation and emergency drawdown procedures. The ill-defined jointly-shared responsibility could be the cause of unforseen legal problems should a collapse or accident occur at this dam.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data

Pursuant to the Recommended Guidelines for Safety Inspection of Dams, Bloodgoods Pond Dam is of small size and significant hazard. Accordingly a spillway design flood of one half the probable maximum flood (PMF) was selected to test the spillway capacity and overtopping potential. Precipitation data was obtained from Hydrometeorological Report No. 33. In accordance with Corps of Engineers directives, the inflow hydrograph and flood routing were obtained utilizing the HEC-1 computer program. Peak inflow to the reservoir for the one half PMF storm was 20,640 cfs (the peak remained approximately the same after being routed through the reservoir). The maximum spillway discharge capacity is calculated to be 13,550 cfs (with flashboards removed). Hence, the spillway can accommodate about 66% of the spillway design flood (SDF).

b. Experience Data

There is a gaging station approximately one mile downstream from the dam site for which stream-flow records are available. The maximum discharge of record is 5,420 cfs in August of 1973. Based on the ratio of the drainage areas, it is estimated that a discharge of 5200 cfs passed over the dam during this storm. With the flashboards in place, the height of water at the dam would have reached elevation 38+ or approximately the elevation of the spillway wingwalls.

From the gage data, the U.S. Geological Survey has performed Log-Pearson type III flood frequency analysis utilizing weighted WRC map skews which gave peak discharge values for a 100-year and 500-year storms of 6,000 cfs

and 9,840 cfs respectively. (These values could be reduced slightly when applied to the study dam). The dam failed in 1971 during the "Doria" hurricane, at which time the discharge was estimated at 4000 cfs. However, the spillway was then much smaller than that now in operation. The failure occured by breaching behind the right wingwall (see Figure 2).

c. Visual Observations

With the flashboards in place, the spillway operates satisfactorily and transmits a relatively uniform low-water flow. Due to the small impoundment area and silted condition of the reservoir, heavier flows are transmitted directly over the dam to the much larger impoundment area above the Jackson Pond Dam.

d. Overtopping Potential

When the design flood of ½ PMF is applied to the dam, overtopping of approximately 2 feet would occur. However, in the case of a 100-year or 500-year frequency event no overtopping would take place. Based on these comparative events, there is potential for overtopping although the likelihood is believed to be relatively small.

e. Drawdown Potential

Bloodgoods Pond Dam would take approximately one day to draw down. This time would be extended if there is a tailwater condition or the hydraulic characteristics of the sluice is impaired.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

Field inspections indicate that the Bloodgoods Pond Dam is in a poor but marginally satisfactory condition within the limitations of the visual observations. The older section of spillway exhibits considerable concrete deterioration, as might be expected. The new spillway and wingwall are in satisfactory condition and show no significant signs of deterioration. The gate structure could not be examined at close range due to its inaccessibility but the external walls are badly eroded. The alignment of this portion appears satisfactory and the interior walls were reportedly refurbished in 1972. The embankment sections of the dam have light brush growth but appear in satisfactory condition, although the crest width on the right end is as narrow as 5 feet in some areas. There is minor bank erosion below the left abutment caused by runoff from an adjacent parking lot but this is not viewed as a hazard to the integrity of the embankment. No seepage or percolation was observed below either embankment. However, there is a natural lagoon area immediately below the right earth embankment which had a water level at the time of inspection of only a few feet below dam crest. There is a rubble wall at the east end of the pond where there may have been an auxiliary spillway in the past. Due to the frozen condition of the ground, it could not be determined whether the pond water level was caused by seepage or overland flow from the adjacent higher ground just to the south. There are several heavily wooded natural drainage swales just below the dam but they are several feet above the downstream channel river bed.

b. Design and Construction Data

Although none of the original design calculations, drawings or construction specifications

were available for evaluation, the plans and sections prepared by E.T. Killam Associates depicted those portions of the original structure remaining after the failure in 1971. The lack of definitive knowledge regarding the foundation thickness of the older spillway was of major concern to the inspection team. While the slab and buttress type of spillway generally exhibits sufficient resistance to overturning, its factor of safety against sliding can be exceedingly marginal. Accordingly, the older spillway section was analyzed utilizing the structural configuration measured in the field in 1972 (however, the thickness of the foundation slab is purely conjectural). The sliding potential was evaluated with the water level at elevation 38 feet (approximately at the top of wingwall). At this hydraulic head, the structure has a safety factor of only 1.08 against sliding, which is considered only marginal and definitely warrants further investigation.

The foundation soils beneath the dam generally consist of recent alluvium that is quite silty with appreciable amounts of clay (both *Bloodgoods and Jackson Pond are heavily* silted up). The underlying stratum are Pleistocene glacial tills of varying depths. These are generally poor draining but contain occasional pockets of gravel. The depth to bedrock is unknown beneath the dam and varies considerably in this area.

The newer ogee-type spillway and embankment are designed and constructed according to contemporary design criteria with appropriately conservative parameters. This portion of spillway is considered to be structurally sound.

c. Operating Records

The Bloodgoods Pond Dam failed during the "Doria" storm in 1971. Failure occurred at the juncture of the right wingwall and embankment, creating a 65 foot wide breach in

the embankment. While the condition of the dam was unknown at the instant of peak flow, it may be assumed that failure resulted from overtopping of the embankment. The height of water above the spillway crest at the time of failure would have been about 3.5 feet. Following the 1972 repairs, in August, 1973, the gaging station at the water plant downstream experienced its maximum discharge of record, 5,420 cfs as previously explained in Section 5.

d. Post Construction Changes

Since the 1972 repairs, there have been no further modifications to the dam. As previously stated, the only observed deterioration since that time has been the erosion of riprapped areas at the downstream ends of the abutment wingwalls.

e. Seismic Stability

The dam is located in Zone 1 and due to its geometry and foundation characteristics has negligible potential vulnerability to seismic loading, as experience indicates that the dam would have adequate stability under dynamic conditions if stable under static loading conditions.

SECTION 7 - ASSESSMENT/RECOMMENDATIONS/ REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety

Subject to the inherent limitations of the Phase I visual inspection, the Bloodgoods Pond Dam appears to be in an overall poor but marginally adequate structural condition. Considerable concrete deterioration exists in the older spillway section and exterior walls of the central flood-gate structure. Additionally, there is some question as to the ability of the older slab and buttress spillway to resist sliding forces during a flood situation comparable to the conditions of evaluation suggested in the Recommended Guidelines for Safety Inspection of Dams. This ambiguity results from the lack of definitive information pertaining to the footing thickness and the underlying foundation materials.

The combined spillway capacity is considered inadequate in accordance with the Corps of Engineers criteria, since only 66% of the spillway design flood can be accommodated without overtopping the dam. It is estimated that the spillway design flood of ½ PMF would overtop the embankment by approximately 2 feet. While some overtopping may be tolerated since those portions of the embankments nearest the spillways are covered with mortared riprap on both the upstream and downstream slopes, the ½ PMF event could cause failure of outer portions of the embankment, especially in the vicinities of the downstream toes of slope at their juncture with the spillway wingwalls.

b. Adequacy of Information

Since a question exists with respect to the ability of the older spillway to resist the sliding forces imposed by an SDF, it is felt

that there is a need for additional investigations to determine the exact configuration of the concrete base slab, the existence and extent of the downstream concrete apron, and the composition of the underlying foundation soils. In view of this, the information available is deemed to be inadequate.

c. Urgency

It is recommended that the additional investigation be undertaken as soon as deemed feasible with respect to weather conditions and discharges at the damsite. Those remedial measures ennumerated below should be considered sometime in the near future in view of the hazard classification and condition of the dam.

d. Necessity for Further Study

It is recommended that additional investigations be made to delineate:

(1) the exact nature of the foundation material, especially under the older buttress spillway;

(2) the configuration and dimensions of the footing in the older spillway section as well as the condition of concrete soffits of the spillway slab;

(3) the extent, thickness and condition of the apron reputed to be located at the downstream toe of the spillway.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

It is recommended that further engineering and hydraulic studies be initiated in the near future as the dam is classified in the significant hazard category and its spillway capacity is inadequate.

a. Alternatives

Should additional site investigations and evaluations reveal that the safety factor against sliding is only marginal, the slab and buttress spillway could possibly be further stabilized by:

(1) Filling the void between the slab and footing with sand or other construction material to provide additional weight. This would require a type of vertical bulkhead construction to retain this material; or,

(2) Driving sheeting along the downstream toe to further anchor the bottom slab; or,

(3) Driving sheeting along the upstream edge of the footing to increase the length of the flow paths thereby reducing uplift; or

(4) Affixing a concrete apron to the downstream toe to further increase sliding resistance.

All disintegrated concrete at the left wingwall, flood-gate structure, and along the slab and buttress spillway should be repaired and/or replaced where deemed necessary. Further, a rapid and safe method of gaining access to the flood-gate structure should be provided, preferably by means of a catwalk. The inoperable 30" Ø sluice gate should be repaired or replaced.

Consideration could be given to increasing the drawdown capacity by either installing additional sluice gates or by providing a permanently affixed system for removing the stop logs (by either hydraulic or mechanical means) during periods of heavy flows. The spillway discharge capacity could be increased by replacing the fixed flashboards with a type specifically designed to fail at a controlled rate when the

water level in the reservoir reaches a predetermined height.

b. O&M Maintenance and Procedures

There are no formalized procedures for the operation or maintenance of Bloodgoods Pond Dam. Therefore, it is felt a more orderly O&M plan should be developed which incorporates the following items:

(1) Responsibility for the operation and maintenance of the dam, reservoir, channels and shorelines should be defined. The Monmouth County Park Commission and the Rahway Water Department, as owner and interested third party respectively, should delineate functional areas of responsibility;

(2) Routine and emergency operational plans should be codified and put into practice by the agency designated for their performance;

(3) Routine maintenance procedures should be outlined and scheduled at regular intervals and correctly recorded;

(4) A regularly scheduled inspection of the dam and appurtenances should be instituted as part of the operational and maintenance plans.

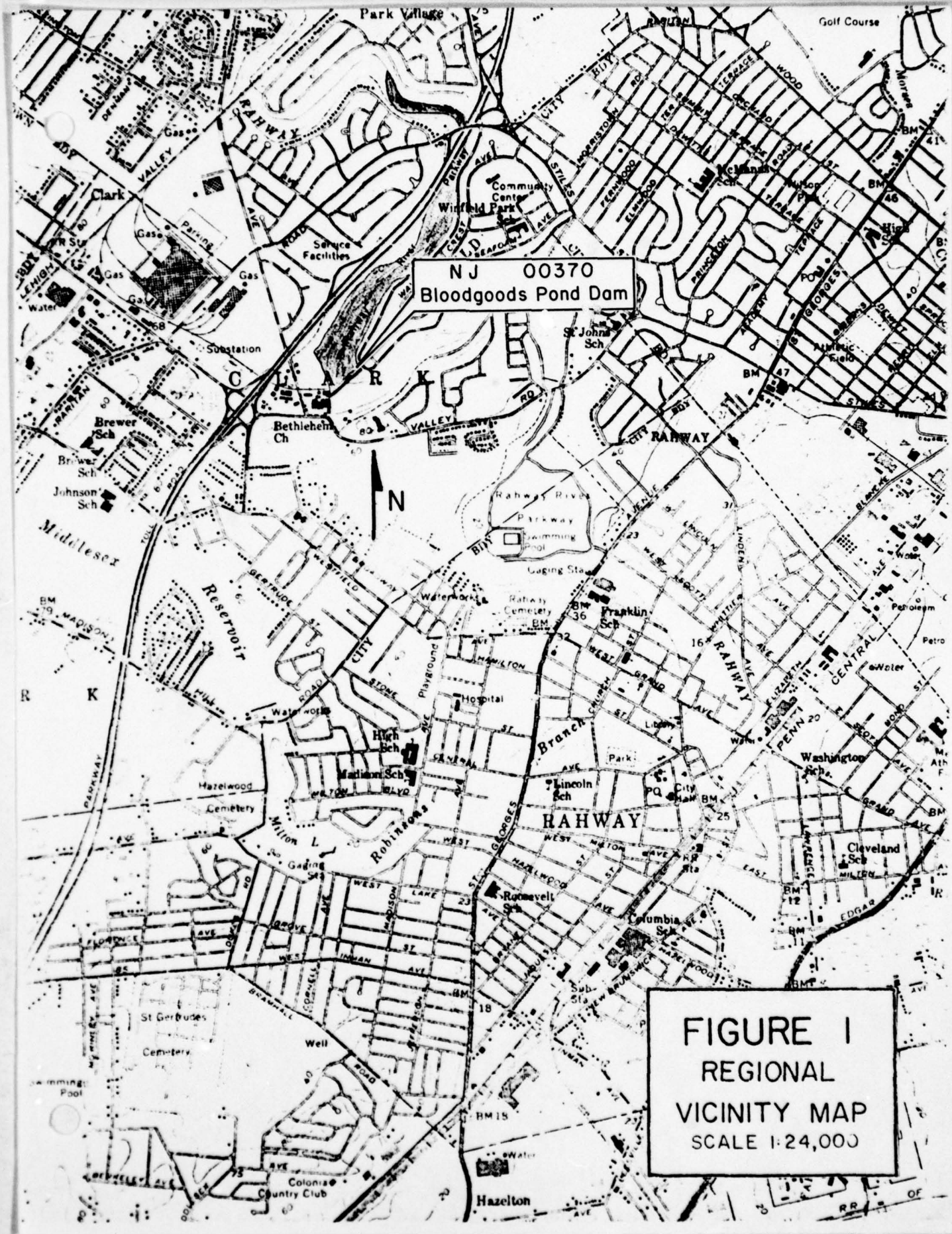


FIGURE 1
REGIONAL
VICINITY MAP
SCALE 1:24,000

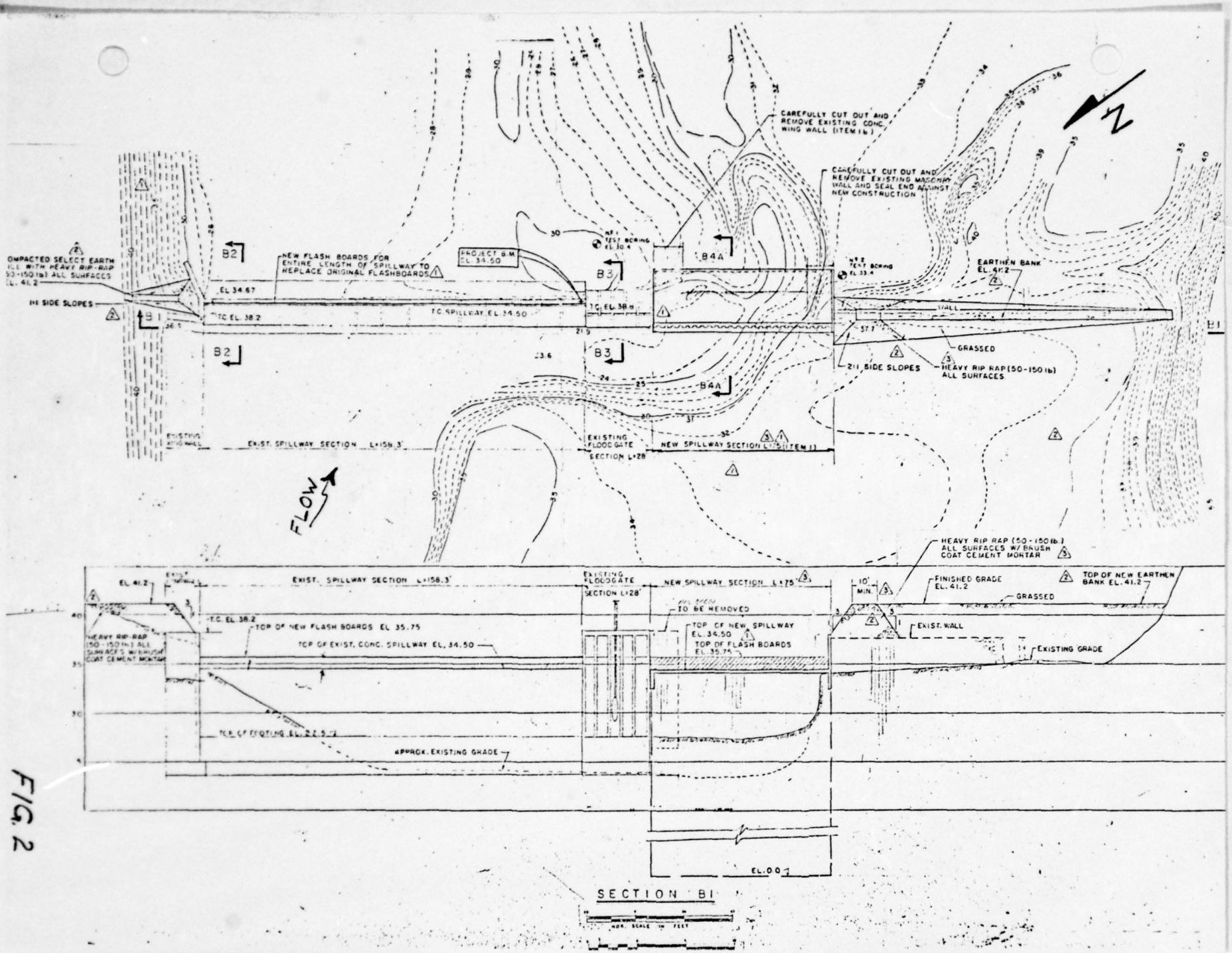

CAREFULLY CUT OUT AND REMOVE EXISTING CONC. WING WALL (ITEM 1b)
CAREFULLY CUT OUT AND REMOVE EXISTING MASONRY WALL AND SEAL END AGAINST NEW CONSTRUCTION
COMPACTED SELECT EARTH FILL WITH HEAVY RIP-RAP (50-150 lb) ALL SURFACES EL. 41.2
1H SIDE SLOPES
NEW FLASH BOARDS FOR ENTIRE LENGTH OF SPILLWAY TO REPLACE ORIGINAL FLASHBOARDS
PROJECT B.M. EL. 34.50
NO. 1 TEST BORING EL. 30.4
NO. 2 TEST BORING EL. 33.4
EARTHEN BANK EL. 41.2
EL. 34.67
T.C. EL. 38.2
T.C. SPILLWAY EL. 34.50
T.C. EL. 38.8
WALL
GRASSED
2:1 SIDE SLOPES
HEAVY RIP RAP (50-150 lb) ALL SURFACES
EXISTING WING WALL
EXIST. SPILLWAY SECTION L=158.3'
EXISTING FLOODGATE SECTION L=28'
NEW SPILLWAY SECTION L=75' (ITEM 1)
FLOW
B1
B2
B3
B4A
HEAVY RIP RAP (50-150 lb.) ALL SURFACES W/ BRUSH COAT CEMENT MORTAR
EL. 41.2
TOP OF NEW FLASH BOARDS EL. 35.75
TOP OF EXIST. CONC. SPILLWAY EL. 34.50
TO BE REMOVED
TOP OF NEW SPILLWAY EL. 34.50
TOP OF FLASH BOARDS EL. 35.75
10' MIN.
FINISHED GRADE EL. 41.2
TOP OF NEW EARTHEN BANK EL. 41.2
EXIST. WALL
EXISTING GRADE
TOE OF FOOTING EL. 22.5
APPROX. EXISTING GRADE
EL. 00.0
SECTION B1
HOR. SCALE IN FEET

FIG. 2

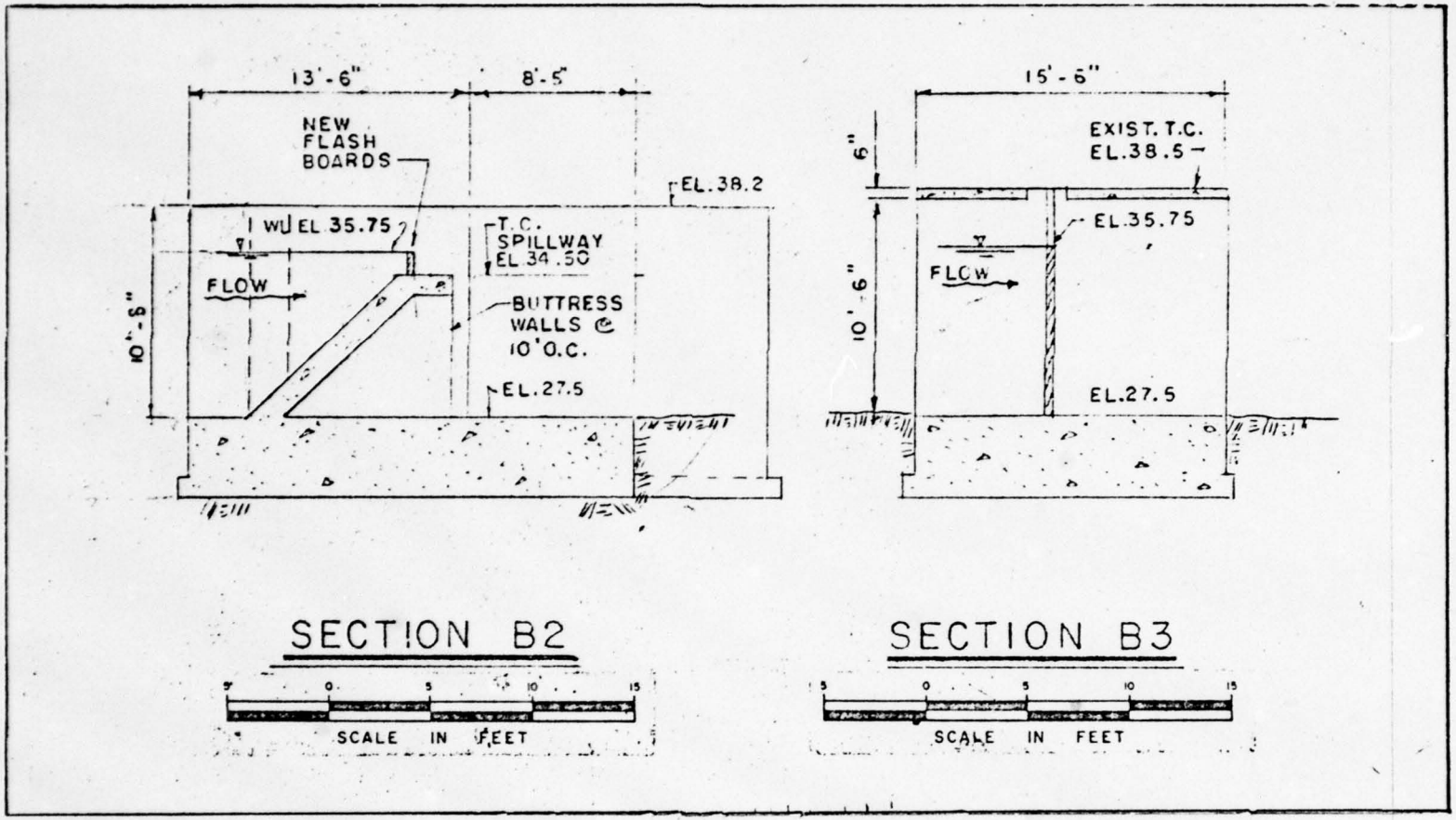
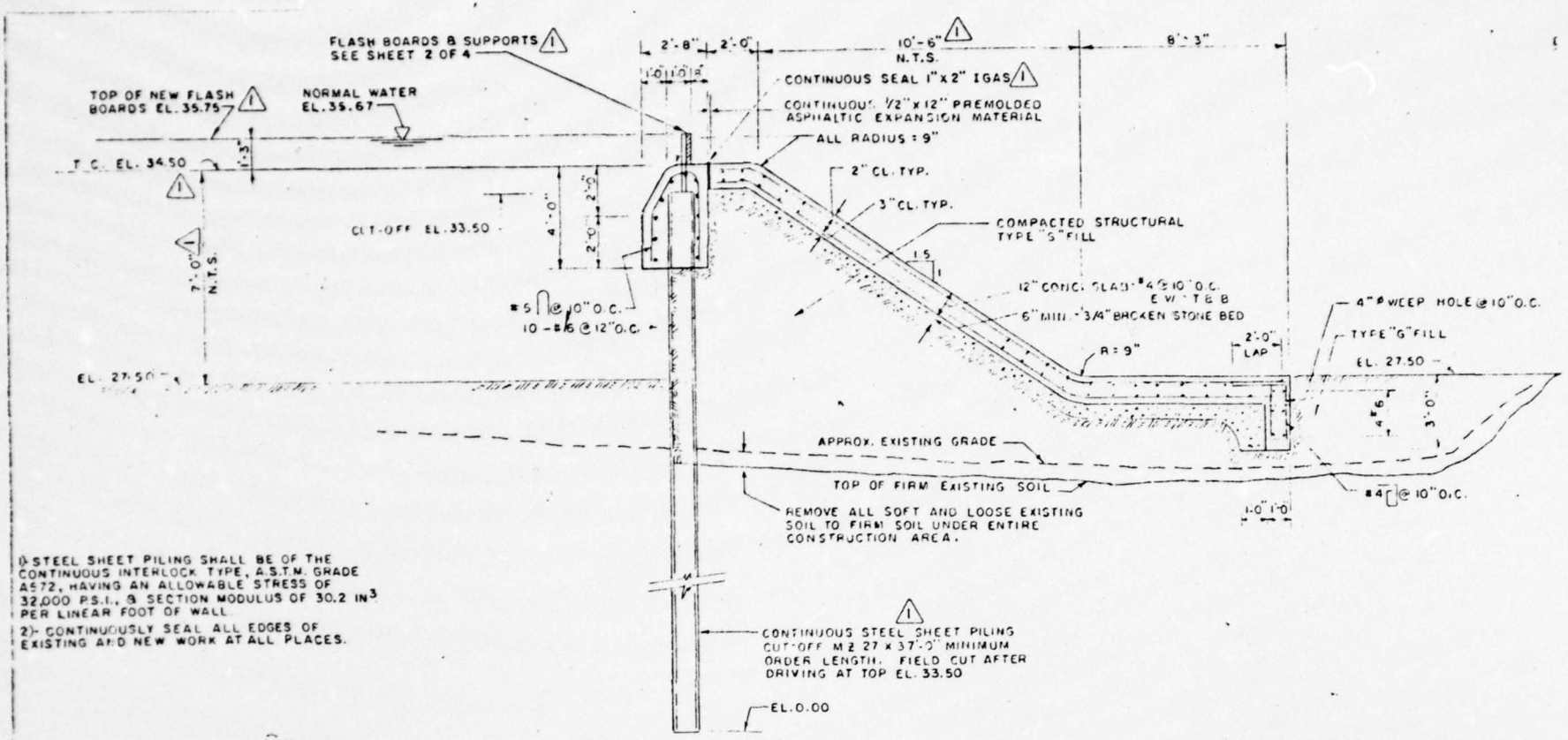

13'-6"
8'-5"
NEW
FLASH
BOARDS
EL.38.2
W.U EL 35.75
T.C.
SPILLWAY
EL 34.50
FLOW
BUTTRESS
WALLS @
10'O.C.
10'-8"
EL.27.5
SECTION B2
SCALE IN FEET
15'-6"
6"
EXIST. T.C.
EL.38.5
EL.35.75
FLOW
10'-6"
EL.27.5
SECTION B3
SCALE IN FEET

Figure 3



SECTION B 4

TYPICAL NEW SPILLWAY SECTION

(ITEM 1a)

Figure 4

Check List
Visual Inspection
Phase 1

Name Dam Bloodgoods Pond Dam County Union State New Jersey Coordinators NJDEP

Date(s) Inspection 12/2,28/78 Weather Clear Temperature 38°F

Pool Elevation at Time of Inspection 34.5 M.S.L. Tailwater at Time of Inspection 27.5 M.S.L.

Inspection Personnel:

Tom Chapter	K. Jolls	
Chhoeur Chhut	G. Simone	

Tom Chapter Recorder

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEE PAGE ON LEAKAGE	None observed	Perched pond downstream of right abutment. Water level appears to coincide with lake level.
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Appears satisfactory. Embankment and abutment overlain with heavy riprap mortared together. Right abutment wall - new riprap on top - old toe eroded and undercut.	Elevation of riprap surface at left embankment ≈ 3.6 feet higher than abutment. Elevation of parking lot is ≈ 3.4 feet higher than embankment, 7 feet higher than abutment.
DRAINS	None observed - left abutment	
WATER PASSAGES	None observed	
FOUNDATION	Unknown - left abutment	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBERSVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Left abutment wing wall eroded at bottom and re-bar exposed. Chamber walls of sluice gate structure severely eroded at base. See photo in Appendices.	Requires rebuilding.
STRUCTURAL CRACKING	Minor cracking observed on left abutment wing wall.	Older downstream portion severely spalled. Requires recapping.
VERTICAL AND HORIZONTAL ALIGNMENT	Appears satisfactory	
MONOLITH JOINTS	Satisfactory	
CONSTRUCTION JOINTS		

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None	Perched pond below right embankment same level as lake. (Fill appears porous with water leaching through).
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Narrow berm on right abutment is eroded on downstream slope.	Left abutment built into natural steep embankment. Many large trees. (Parking lot above).
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	Crest appears too narrow.	
RIPRAP FAILURES	Toe at right wing - eroded out - needs cut-off wall.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Satisfactory	
ANY NOTICEABLE SEEPAGE	Possible seepage near toe of right embankment.	
STAFF GAGE AND RECORDER	Gage located about 2 miles downstream.	
DRAINS	None	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	N/A	
INTAKE STRUCTURE	N/A	
OUTLET STRUCTURE	Chamber walls badly deteriorated at base and downstream edge.	
OUTLET CHANNEL	Natural stream valley with several channels of flow (braided channel).	
EMERGENCY GATE	N/A	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Weir on right is new and in good shape. Weir on slab and buttress spillway seems spalled along cap as well as edges of buttresses beneath slab.	Older spillway requires refurbishing.
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE AND PIERS	Concrete piers buttressing left spillway slabs somewhat deteriorated from cavitation.	Requires refurbishing.

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	N/A	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE AND PIERS	N/A	
GATES AND OPERATION EQUIPMENT	N/A	

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER	Stream flow gage located 2 miles downstream maintained by Rahway Water Department.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Shoreline banks rise on 2:1 slope to roadways encircling lake. Parking lot 20' above right abutment. Riprap slopes are 1:1.	Tree lined banks appear relatively stable although steeper sections exhibit 1' to 3' deep erosion channels. These should be filled and seeded or sodded.
SEDIMENTATION	Impossible to determine although the 1972 report mentions heavy siltation and need for flashboards to increase storage capacity.	It is possible the 1971 failure may have scoured the reservoir channel bottom somewhat.
OTHER	Garbage dump just below parking lot. All immediately surrounding buildings are 15-20 feet above crest.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Wide wooded valley with numerous braided channels. Main channel clear - 40-50 feet wide.	
SLOPES	Steep wooded slopes with erosion gullies common.	
APPROXIMATE NO. OF HOMES AND POPULATION	Hundreds of homes downstream. Area to left of dam @ Winfield Park is low income housing and about 15 feet above downstream channel. Grade school on right bank about 40-50 feet above channel and several hundred feet back from slope.	Most seem to be at elevation high enough to preclude flood damage. Jackson Pond Dam and Valley Road downstream.

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Plan and section prepared by Killam Associates 1972. Sheet 1
REGIONAL VICINITY MAP	USGS and Killam Associates.
CONSTRUCTION HISTORY	Original history unknown. Repaired in 1972.
TYPICAL SECTIONS OF DAM	Prepared by Killam Associates 1972. Sheet 1 and 3
HYDROLOGIC/HYDRAULIC DATA	Prepared by Killam Associates 1972.
OUTLETS - PLAN	Prepared by Killam Associates 1972. Sheet 2
- DETAILS	Prepared by Killam Associates 1972. Sheet 2
-CONSTRAINTS -DISCHARGE RATINGS	Prepared by Killam Associates 1972.
RAINFALL/RESERVOIR RECORDS	Collected by Rahway Water Department from St. George Avenue station.

ITEM	REMARKS
DESIGN REPORTS	Not available
GEOLOGY REPORTS	Not available
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Hydraulic computations for sizing of spillway prepared by Killam Associates 1972 appear accurate.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	One 34' deep boring performed at site by Haller Testing Labs.
POST-CONSTRUCTION SURVEYS OF DAM	None
BORROW SOURCES	Unknown

ITEM	REMARKS
MONITORING SYSTEMS	None at dam
MODIFICATIONS	Extensive repairs and enlargement of spillway discharge capacity in 1972.
HIGH POOL RECORDS	No record
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Repair report prepared by Killam Associates 1972.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	Failure of embankment (August 1971) replaced with new spillway in 1972.
MAINTENANCE OPERATION RECORDS	None available

ITEM	REMARKS
SPILLWAY PLAN	Additional information required with respect to old spillway in order to evaluate stability.
SECTIONS	
DETAILS	
OPERATING EQUIPMENT PLANS & DETAILS	None available

View of crest from east abutment

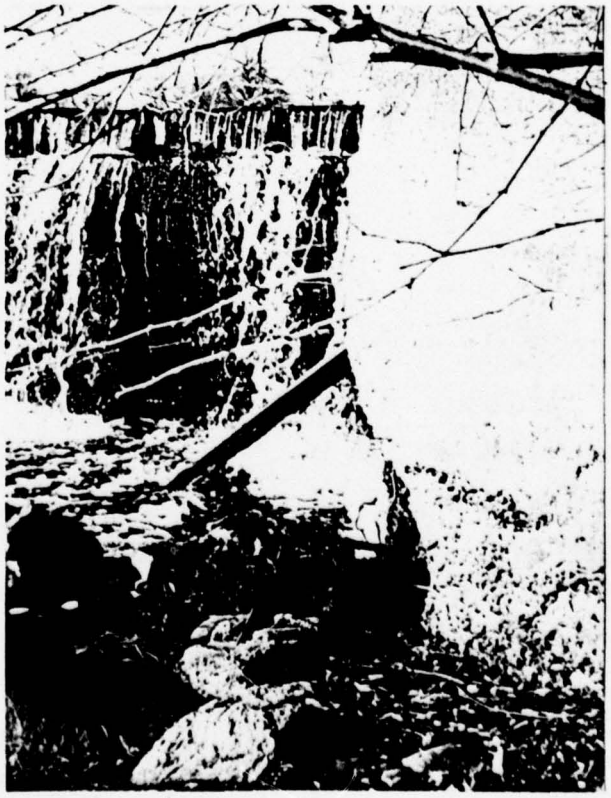
December 1978

Downstream view of dam

October 1978

View of floodgate structure

December 1978



View of east wingwall

December 1978

December, 1978

View of left embankment

December, 1978

View of right embankment

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Extensive urbanization (39.3 sq.mi.)

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 34.5 M.S.L. (75 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): N/A

ELEVATION MAXIMUM DESIGN POOL: 35.75 MSL

ELEVATION TOP DAM: 41.2 MSL

CREST: Consists of 2 spillways separated by gate structure

a. Elevation 34.5 MSL
b. Type Slab and buttress on left. Ogee on right.
c. Width 2' on left. 3' on right.
d. Length 158' on left. 75' on right.
e. Location Spillover
f. Number and Type of Gates 1-30" screw operated sluice gate.

OUTLET WORKS: Sluice gate structure

a. Type 5 chamber gate structure with stop logs in 4 chambers and 1 gate.
b. Location Center of dam
c. Entrance inverts 29 MSL
d. Exit inverts 29 MSL
e. Emergency draindown facilities Same

HYDROMETEOROLOGICAL GAGES:

a. Type Water-stage recorder
b. Location St.George Av.Bridge over Rahway River 2 mi. below dam.
c. Records 7/1908-4/1915, 10/1921 - Present; Records good.

MAXIMUM NON-DAMAGING DISCHARGE: 13,550 cfs

BY. D. J. M DATE 12-78 | **LOUIS BERGER & ASSOCIATES INC.** | SHEET NO A1 OF.

CHKD. BY DATE | BLOODGOODS POND DAM INSPECTION | PROJECT C227

SUBJECT

Clark Parameters for HEC-1 Input

$$T_c = 8.29 \times (1.0 + 0.03I)^{-1.28} \times \left(\frac{DA}{S}\right)^{0.28}$$

WHERE :

I = impervious cover index in percent = 29 %

(Population ≈ 4970 persons/sq mile $I = 0.117(D)^{(0.792 - 0.039 \log D)}$)

S = Slope in feet per mile = 24

DA = Drainage area in sq miles = 39.3

$\therefore T_c = 4.27$ hours

$$\frac{R}{T_c + R} = 0.65$$

$$\therefore R = (4.27 + R) \times 0.65$$

$$\therefore R - 0.65R = 2.78$$

$$\therefore R = 2.78 / 0.35 = 7.94$$

BY DJM DATE 12-78 LOUIS BERGER & ASSOCIATES INC. SHEET NO A2 OF
CHKD. BY DATE BLOODGOODS POND DAM PROJECT C227
SUBJECT

PRECIPITATION DATA FOR P CARD FOR

HEC-1 INPUT

PMP

24 hour precipitation for 200 sq miles = 23"

Maximum 6 hour percentage of PMF = 100

" 12 " " " = 109

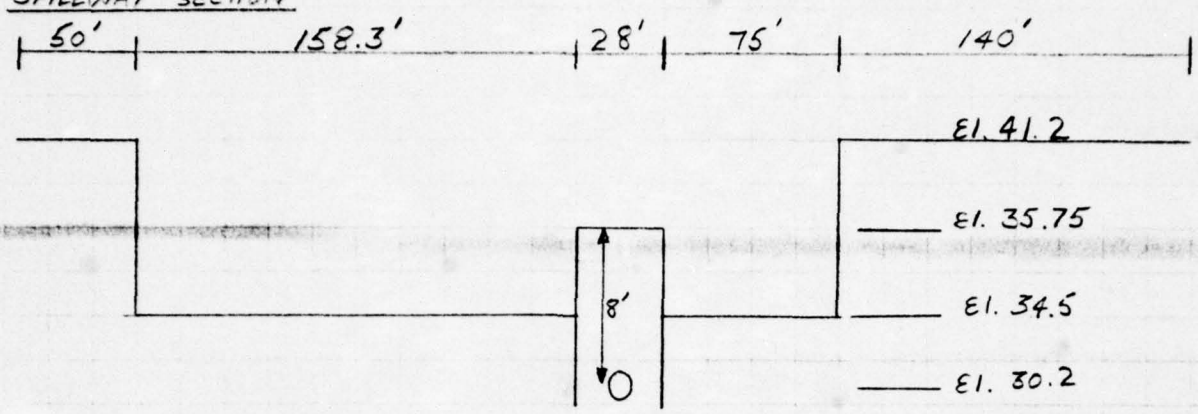
" 24 " " " = 118

BY D.J.M. DATE 12-78 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A3 OF

CHKD. BY ____ DATE ____ BLOODGOODS POND DAM INSPECTION PROJECT C227

SUBJECT Spillway discharge

SPILLWAY SECTION



DISCHARGE

LEFT SPILLWAY L = 158.3'			RIGHT SPILLWAY L = 75'			OVER DAM L = 190'		
H	C	Q	H	C	Q	H	C	Q
1	3.0	475	1	3.3	248			
2	3.0	1343	2	3.3	700			
3	3.0	2468	3	3.3	1286			
4	3.0	3799	4	3.3	1980			
5	3.0	5310	5	3.3	2767			
6	3.0	6980	6	3.3	3637			
7	3.0	8795	7	3.3	4584	0.3	2.7	84
8	3.0	10746	8	3.3	5600	1.3	2.7	760
9	3.0	12822	9	3.3	6683	2.3	2.7	1789

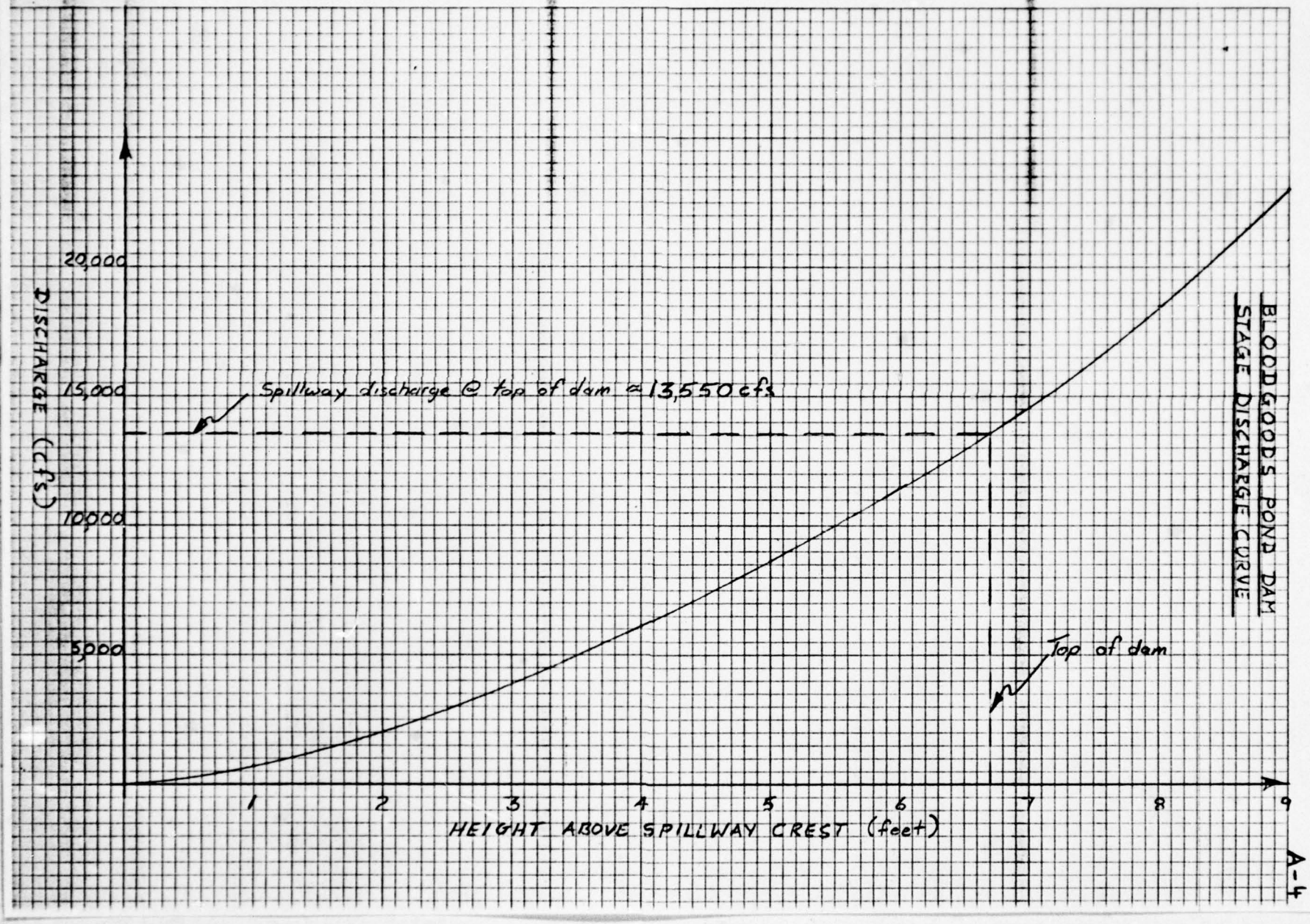
Over SLUICE L = 28'

H	C	Q
0.75	2.8	51
1.75	2.8	181
2.75	2.8	358
3.75	2.8	569
4.75	2.8	812
5.75	2.8	1081
6.75	2.8	1375
7.75	2.8	1691

ΣQ

H	Q
1	723
2	2,094
3	3,935
4	6,137
5	8,646
6	11,429
7	14,544
8	18,481
9	22,985

46 0706



BLOODGOODS POND DAM
STAGE DISCHARGE CURVE

A-4

BY LB DATE 12/13

CHKD. BY ____ DATE ____

SUBJECT SURCHARGE STORAGE

LOUIS BERGER & ASSOCIATES INC.

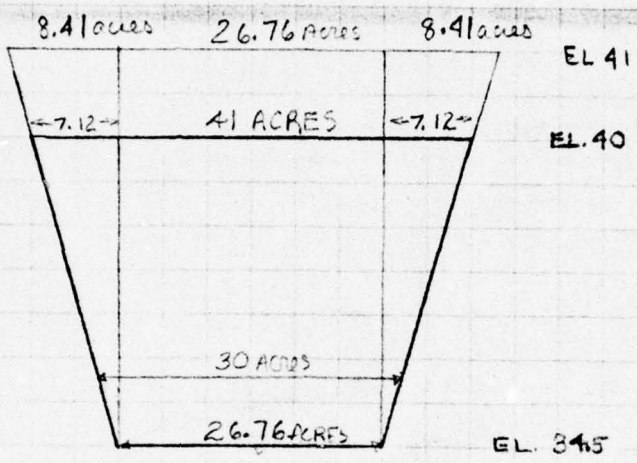
BLOODGOOD'S POND DAM #1

SHEET NO A5 OF

PROJECT C-277

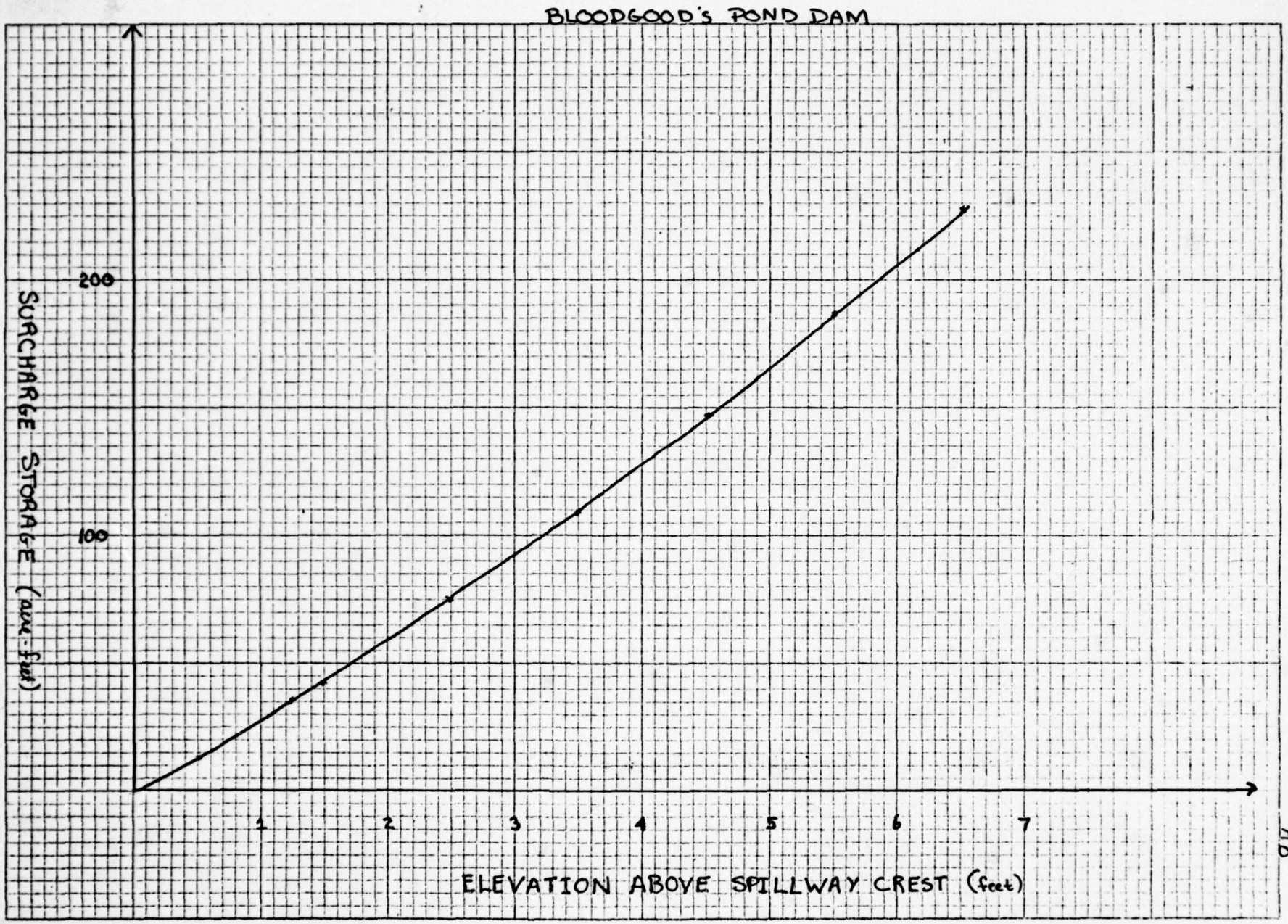
Area - LAKE = 30 ACRES (FROM DAM APPLICATION)

40' CONTOUR = 41 ACRES (PLANIMETERED)



Volume = $26.76(x) + x^2\left(\frac{8.41}{6.5}\right)$

HEIGHT ABOVE SPILLWAY CREST	SURCHARGE STORAGE (ACRE FEET)
0	0
1	28
2	59
3	92
4	128
5	166
6	207
7	251
7.5	274
8	297
9	346



BY D.J.M DATE 12-78

CHKD. BY _____ DATE _____

SUBJECT _____

LOUIS BERGER & ASSOCIATES INC.

BLOODGOOD POND DAM INSPECTION

SHEET NO. A7 OF

PROJECT C227

SUMMARY OF STORAGE/DISCHARGE FOR HEC-1

HEIGHT ABOVE SPILLWAY CREST (FEET)	STORAGE (ACRE FEET)	DISCHARGE (cfs)
1	28	723
2	59	2,094
3	92	3,935
4	128	6,137
5	166	8,646
6	207	11,429
7	251	14,544
7.5	274	16,400
8	297	18,481
9	346	22,985

BY D.J.M. DATE 12-78 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A8 OF

CHKD. BY DATE BLOODGOOD POND DAM PROJECT C227

SUBJECT APPROXIMATE DRAWDOWN CALCULATION

APPROX VOLUME = 75.0 acre feet.

INVERT EL. OF PIPE = 28.95

HEAD = 5.55'

Assume drawdown in two stages

Stage 1. Volume = $\frac{75.0 \times 43560}{2}$ c.f.

head = 4.16' c = 0.55

Discharge = 44 cfs

time = $\frac{75.0 \times 43560}{2 \times 44 \times 3600}$ = 10.3 hours

Stage 2 Volume as above

head = 1.4' c = 0.5

Discharge ≈ 25 cfs

time = $\frac{75.0 \times 43560}{2 \times 25 \times 3600}$ ≈ 18.2 hours

Σ time ≈ 1 day

BY D.J.M. DATE

CHKD. BY DATE

SUBJECT

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. A-2 OF

PROJECT C-227

BLOODGOOD'S POND DAM

BLOODGOODS POND DAM INSPECTION NORTH GROUP C227
BY D.J.MULLIGAN
DECEMBER 1978

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
100	0	30	0	0	0	0	0	3	0

JOPER	NWT
3	0

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
1	0	0	0	1	0	1

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	0	39.30	0.0	39.30	0.0	0.500	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.0	23.00	100.00	109.00	118.00	0.0	0.0	0.0

TRSPC COMPUTED BY THE PROGRAM IS 0.843

LOSS DATA

STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0.0	0.0	1.00	0.0	0.0	1.00	0.50	0.10	0.0	0.0

UNIT HYDROGRAPH DATA

TC= 4.27 R= 7.94 NTA= 0

RECESSION DATA

STRTQ= 0.0 QRCSN= 0.0 RTIOR= 1.00

UNIT HYDROGRAPH 89 END-OF-PERIOD ORDINATES, LAG= 4.11 HOURS, CP= 0.39 VOL= 1.00

88.	330.	678.	1090.	1532.	1929.	2226.	2412.	2432.	2319.
2177.	2044.	1919.	1802.	1692.	1589.	1492.	1401.	1315.	1235.
1160.	1089.	1022.	960.	901.	846.	795.	746.	701.	658.
618.	580.	544.	511.	480.	451.	423.	397.	373.	350.
329.	309.	290.	272.	256.	240.	225.	212.	199.	187.
175.	165.	154.	145.	136.	128.	120.	113.	106.	99.
93.	88.	82.	77.	73.	68.	64.	60.	56.	53.
50.	47.	44.	41.	39.	36.	34.	32.	30.	28.
26.	25.	23.	22.	21.	19.	18.	17.	16.	

END-OF-PERIOD FLOW

TIME	RAIN	EXCS	COMP Q
1	0.06	0.00	0.
2	0.06	0.00	0.
3	0.06	0.00	0.

BY DJM DATE

CHKD. BY DATE

SUBJECT

LOUIS BERGER & ASSOCIATES INC.

BLOODGOODS POND DAM

SHEET NO. A-10 OF

PROJECT C-227

4	0.06	0.00	0.
5	0.06	0.00	0.
6	0.06	0.00	0.
7	0.06	0.00	0.
8	0.06	0.00	0.
9	0.06	0.00	0.
10	0.06	0.01	2.
11	0.06	0.01	6.
12	0.06	0.01	13.
13	0.15	0.10	31.
14	0.15	0.10	73.
15	0.15	0.10	149.
16	0.15	0.10	263.
17	0.15	0.10	416.
18	0.15	0.10	604.
19	0.15	0.10	817.
20	0.15	0.10	1045.
21	0.15	0.10	1273.
22	0.15	0.10	1491.
23	0.15	0.10	1695.
24	0.15	0.10	1887.
25	0.97	0.92	2140.
26	0.97	0.92	2581.
27	1.16	1.11	3316.
28	1.16	1.11	4427.
29	1.45	1.40	5986.
30	1.45	1.40	8015.
31	3.68	3.63	10664.
32	3.68	3.63	14195.
33	1.36	1.31	18494.
34	1.36	1.31	23198.
35	1.07	1.02	28019.
36	1.07	1.02	32613.
37	0.09	0.04	36530.
38	0.09	0.04	39414.
39	0.09	0.04	41019.
40	0.09	0.04	41272.
41	0.09	0.04	40501.
42	0.09	0.04	39122.
43	0.09	0.04	37370.
44	0.09	0.04	35402.
45	0.09	0.04	33391.
46	0.09	0.04	31467.
47	0.09	0.04	29662.
48	0.09	0.04	27966.
49	0.0	0.0	26371.
50	0.0	0.0	24864.
51	0.0	0.0	23435.
52	0.0	0.0	22076.
53	0.0	0.0	20782.
54	0.0	0.0	19548.
55	0.0	0.0	18374.
56	0.0	0.0	17260.
57	0.0	0.0	16207.
58	0.0	0.0	15218.
59	0.0	0.0	14289.
60	0.0	0.0	13417.
61	0.0	0.0	12597.
62	0.0	0.0	11828.
63	0.0	0.0	11106.
64	0.0	0.0	10428.

BY D.J.M. DATE

CHKD. BY DATE

SUBJECT

LOUIS BERGER & ASSOCIATES INC.

BLOODGOODS POND DAM

SHEET NO. A-11 OF

PROJECT G-227

65	0.0	0.0	9792.
66	0.0	0.0	9194.
67	0.0	0.0	8633.
68	0.0	0.0	8105.
69	0.0	0.0	7611.
70	0.0	0.0	7146.
71	0.0	0.0	6710.
72	0.0	0.0	6300.
73	0.0	0.0	5915.
74	0.0	0.0	5554.
75	0.0	0.0	5215.
76	0.0	0.0	4897.
77	0.0	0.0	4598.
78	0.0	0.0	4317.
79	0.0	0.0	4054.
80	0.0	0.0	3806.
81	0.0	0.0	3574.
82	0.0	0.0	3356.
83	0.0	0.0	3151.
84	0.0	0.0	2958.
85	0.0	0.0	2778.
86	0.0	0.0	2608.
87	0.0	0.0	2449.
88	0.0	0.0	2299.
89	0.0	0.0	2159.
90	0.0	0.0	2027.
91	0.0	0.0	1904.
92	0.0	0.0	1787.
93	0.0	0.0	1678.
94	0.0	0.0	1576.
95	0.0	0.0	1480.
96	0.0	0.0	1389.
97	0.0	0.0	1304.
98	0.0	0.0	1224.
99	0.0	0.0	1150.
100	0.0	0.0	1080.
SUM	22.98	20.49	1018108.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	41272.	36480.	19524.	10181.	1018108.
INCHES		8.63	18.49	20.08	20.08
AC-FT		18099.	38746.	42092.	42092.

RUNOFF MULTIPLIED BY 0.50

0.	0.	0.	0.	0.	0.	0.	0.	0.	1.
1.	6.	15.	37.	75.	132.	208.	302.	409.	522.
637.	746.	848.	944.	1070.	1290.	1658.	2214.	2993.	4007.
5332.	7093.	9247.	11559.	14010.	16307.	18265.	19707.	20510.	20636.
20250.	19561.	18685.	17701.	16695.	15734.	14831.	13983.	13165.	12432.
11717.	11038.	10391.	9779.	9187.	8630.	8104.	7609.	7144.	6708.
6299.	5914.	5553.	5214.	4896.	4597.	4316.	4053.	3805.	3573.
3355.	3150.	2958.	2777.	2608.	2448.	2299.	2159.	2027.	1903.
1787.	1678.	1575.	1479.	1389.	1304.	1224.	1150.	1080.	1014.
952.	894.	839.	788.	740.	695.	652.	612.	575.	540.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	20636.	18240.	9762.	5091.	509052.
INCHES		4.32	9.24	10.04	10.04
AC-FT		9049.	19373.	21046.	21046.

BY D.J.M. DATE

CHKD. BY DATE

SUBJECT

LOUIS BERGER & ASSOCIATES INC.

BLOODGOODS POND DAM

SHEET NO. A-12 OF

PROJECT 6-227

HYDROGRAPH ROUTING

ROUTING THROUGH RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
11	1	0	0	1	0	1

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.0	0.0	1	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	0.

STORAGE=	0.	59.	92.	128.	166.	207.	251.	274.	297.	346.
OUTFLOW=	0.	2094.	3935.	6137.	8646.	11429.	14544.	16400.	18471.	22585.

TIME	EOP STOR	AVG IN	EOP OUT
1	0.	0.	0.
2	0.	0.	0.
3	0.	0.	0.
4	0.	0.	0.
5	0.	0.	0.
6	0.	0.	0.
7	0.	0.	0.
8	0.	0.	0.
9	0.	0.	0.
10	0.	1.	0.
11	0.	2.	2.
12	0.	5.	4.
13	0.	11.	10.
14	1.	26.	23.
15	1.	56.	51.
16	3.	103.	95.
17	4.	170.	158.
18	7.	255.	240.
19	10.	355.	338.
20	13.	466.	446.
21	16.	580.	559.
22	19.	691.	671.
23	22.	797.	777.
24	25.	896.	877.
25	28.	1007.	987.
26	32.	1180.	1150.
27	40.	1474.	1424.
28	52.	1936.	1857.
29	68.	2603.	2493.
30	85.	3500.	3365.
31	106.	4670.	4483.
32	132.	6215.	6390.
33	163.	8172.	8447.
34	197.	10423.	10752.
35	232.	12804.	13178.
36	264.	15158.	15582.
37	289.	17286.	17767.
38	307.	18986.	19360.
39	317.	20108.	20340.
40	321.	20573.	20645.
41	318.	20443.	20381.

42	311.	19906.	19758.
43	302.	19123.	18926.
44	291.	18193.	17969.
45	280.	17199.	16965.
46	269.	16214.	16004.
47	258.	15282.	15102.
48	247.	14407.	14249.
49	236.	13584.	13459.
50	225.	12809.	12686.
51	214.	12075.	11960.
52	205.	11378.	11271.
53	195.	10714.	10621.
54	186.	10082.	9992.
55	177.	9481.	9395.
56	169.	8908.	8827.
57	161.	8367.	8294.
58	153.	7856.	7789.
59	146.	7377.	7313.
60	139.	6926.	6867.
61	133.	6504.	6448.
62	127.	6106.	6057.
63	121.	5734.	5696.
64	115.	5384.	5347.
65	110.	5055.	5021.
66	105.	4746.	4714.
67	100.	4457.	4427.
68	96.	4185.	4156.
69	91.	3929.	3904.
70	87.	3689.	3674.
71	83.	3464.	3449.
72	80.	3253.	3239.
73	76.	3054.	3041.
74	73.	2867.	2855.
75	70.	2692.	2681.
76	67.	2528.	2517.
77	64.	2374.	2364.
78	61.	2229.	2219.
79	59.	2093.	2086.
80	56.	1965.	1984.
81	53.	1845.	1866.
82	49.	1732.	1753.
83	46.	1627.	1646.
84	44.	1527.	1546.
85	41.	1434.	1451.
86	38.	1347.	1363.
87	36.	1264.	1279.
88	34.	1187.	1201.
89	32.	1115.	1128.
90	30.	1047.	1059.
91	28.	983.	994.
92	26.	923.	934.
93	25.	866.	877.
94	23.	813.	823.
95	22.	764.	773.
96	20.	717.	726.
97	19.	673.	681.
98	18.	632.	640.
99	17.	594.	601.
100	16.	557.	564.
SUM			508679.

BY D.J.M. DATE ________ **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A-14 OF ____

CHKD. BY ______ DATE ________ BLOODGOODS POND DAM PROJECT C-227

SUBJECT ____________________

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	20645.	18233.	9759.	5087.	508679.
INCHES		4.32	9.24	10.03	10.03
AC-FT		9046.	19367.	21031.	21031.

********** ********** ********** ********** **********

RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	1	20636.	18240.	9762.	5091.	39.30
ROUTED TO	11	20645.	18233.	9759.	5087.	39.30

BY_____ DATE_____ **LOUIS BERGER & ASSOCIATES INC.** SHEET NO._____ OF

CHKD. BY_____ DATE_____ BLOODGOODS DAM PROJECT_____

SUBJECT_____

STABILITY COMPUTATIONS

BY LBT DATE DEC 76 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A 15 OF.
CHKD. BY LB DATE 12-76 BLOOD GOODS DAM PROJECT C-227
SUBJECT CHECK FOR SLIDING

REF DRG : SHEET 1 BY E.T. KILLAM ASSOCIATES

DIMENSIONS NOT SHOWN ON SECTION B2, HAVE BEEN SCALED.

ASSUMPTIONS

UP STREAM WATER EL = 35.0

DN STREAM " " = 27.50

SOIL PROPERTIES (DN STREAM SIDE)

ϕ = 33°

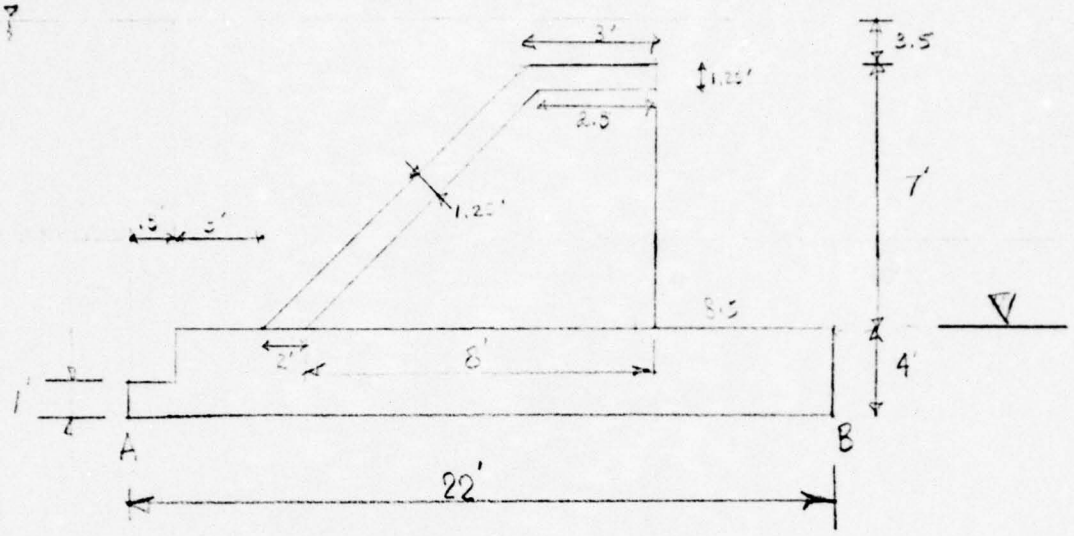
γ_s = 110 lb/cft

μ = 0.50

BY L.G. DATE 12/12 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A 16 OF

CHKD. BY W.T. DATE BLOODGOOD'S DAM PROJECT 6227

SUBJECT STABILITY COMPUTATIONS



CONSIDER ALL FORCES FOR 10' OF DAM

FOOTING: $1 \times 5 \times 10' \times 150\ ^{lb}/_{ft^3}$ 750 lbs

$21.5 \times 4' \times 10' \times 150\ ^{lb}/_{ft^3}$ 129 000 lbs

INCLINED WALL $\frac{1}{2}(7)(3+10) - \frac{1}{2}(5.75)(2.5+8)] \times 10 \times 150\ ^{lb}/_{ft^3}$ 22969

BUTTRESS $\frac{1}{2}(5.75)(2.5+8)(1)(150)$ 4528.13

WEIGHT OF WATER $.5 \times (13.5) \times 10 \times 62.4\ ^{lb}/_{ft^3} =$ 4212

$3 \times 10.5' \times 10 \times 62.4\ ^{lb}/_{ft^3} =$ 19656

$\frac{1}{2}(7)(3.5+10.5) \times 10 \times 62.4\ ^{lb}/_{ft^3} =$ 30576

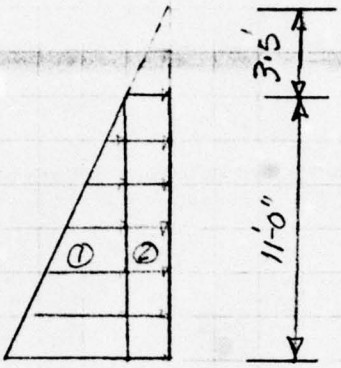
Σ 211.69 kips

BY LB DATE 12/78 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A 17 OF
CHKD. BY LHT DATE BLOODGOOD'S DAM PROJECT C-227
SUBJECT STABILITY COMPUTATIONS

HORIZONTAL FORCES

WATER PRESSURE

UPSTREAM

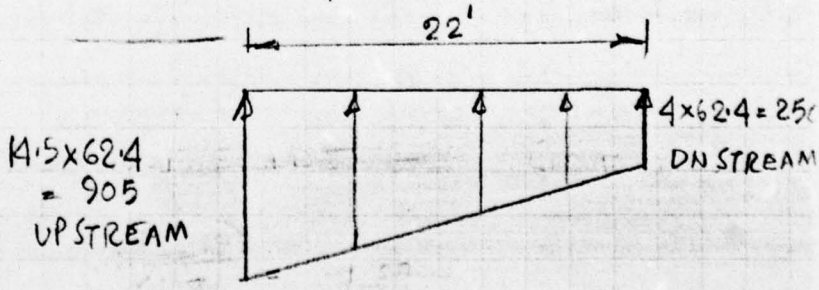


① $\frac{11^2 \times 62.4 \times 10}{2}$ = 37.75 kips

② $62.4 \times 3.5 \times 10 \times 11$ = 24 kips

Σ = 61.8 kips

UP LIFT PR.



TOTAL UPLIFT = $\left(\frac{905+250}{2}\right) \times 22 \times 10$ = 127.05K

BY LP DATE ____ CHKD. BY LBT DATE ____ SUBJECT STABILITY COMPUTATIONS

LOUIS BERGER & ASSOCIATES INC.

BLOODWOOD'S DAM

SHEET NO. A18 OF

PROJECT C-227

DN STREAM

PASSIVE EARTH PRESSURE

$\phi = 33°$ ∴ $K_p = 3.39$ $\quad K_p = \tan^2(45 + \frac{\phi}{2})$

PASSIVE EARTH PRESSURE = $.6 \times 110^{\#}/ft^3 \times 10 \times 4^2/2 \times 3.39$

($130^{\#}/ft^3 - 62.4^{\#}/ft^3 = 67.6 \approx .6 \times 110$) (satur. unit wgt)

$= 17.899$ k.

WATER PR ____ $= 62.4 \times 10 \times \frac{4}{2}^2 = 4.99$ k

FACTOR OF SAFETY AGAINST SLIDING ASSUMING COEFF OF FRICTION = 0.50

$$= \frac{0.5\,(211.69 - 127.05)}{(61.8 - 17.899 - 4.99)} = 1.08$$

MARGINALLY SAFE.

BY LBT DATE DEC'75 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A-19 OF.
CHKD. BY LB DATE 12-75 BLOOD GOOD'S DAM PROJECT C-227
SUBJECT CHECK FOR SOIL PRESSURES

CHECK FOR SOIL PRESSURES

TAKE MOMENTS ABOUT 'B'

VERTICAL FORCE		ARM.	M_B (kip-ft)
FOOTING.	750	21.75	16312
	129000	10.75	1386750
SLAB	$\frac{(3+2.5)}{2} \times 1.25 \times 10 \times 150 = 5156$	9.875	50915
	$9.5 \times 1.25 \times 10 \times 150 = 17812$	13.75	244915
BUTTRESS	$2.5 \times 5.75 \times 150 = 2156$	9.75	21021
	$\frac{5.5 \times 5.75}{2} \times 150 = 2372$	12.83	30433.
WT. OF WATER.	4212	21.75	91611
	19656	20.00	393120
	$7 \times 3.5 \times 10 \times 62.4 = 15288$	15.0	229320
	$\frac{7 \times 7 \times 62.4 \times 10}{2} = 15288$	16.16	247054.
	Σ 211.69 K		2711.45 K'

BY LBT DATE DEC'78 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A 29 OF
CHKD. BY LB DATE 12-X BLOOD GOOD'S DAM PROJECT C-227
SUBJECT

HORIZ. FORCES

WATER PR. (UPSTREAM)

37.75	$\frac{11}{3}$	138.41 k'
24.00	$\frac{11}{2}$	132.00
		270.41

WATER PR. (DN STREAM)

- 4.99	$\frac{4}{3}$	- 6.67
EARTH PR. - 17.899	$\frac{4}{3}$	- 23.87
	Σ	239.87 k'

$$\text{ECC. OF RESULTANT} = 11 - \frac{(2711.45 - 239.87)}{211.69}$$

$$= 11 - 11.68$$

$$= -0.68$$

$$\text{SOIL PR} = \frac{211.69}{10 \times 22}\left(1 \pm \frac{6 \times 0.68}{22}\right)$$

MAX = 1.14 KSF

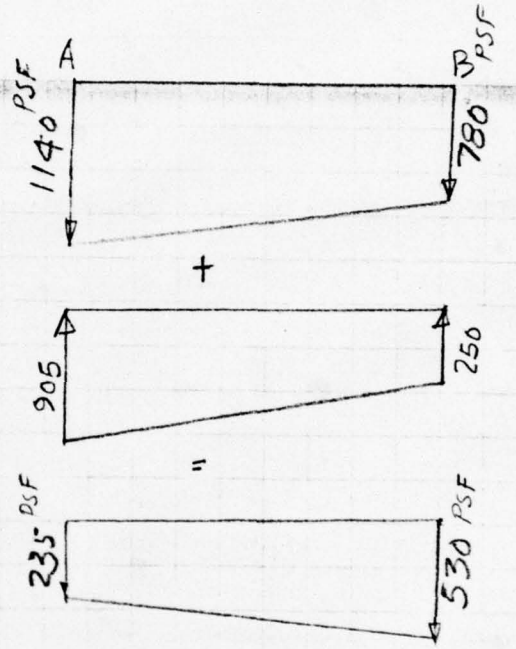
MIN = 0.78 KSF

BY LBT DATE DEC '78 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A 21 OF

CHKD. BY LB DATE 12-78 BLOOD GOOD'S DAM PROJECT C-227

SUBJECT

PRESSURES UNDER THE FOOTING



BY LB DATE

CHKD. BY DATE

SUBJECT STABILITY COMPUTATIONS

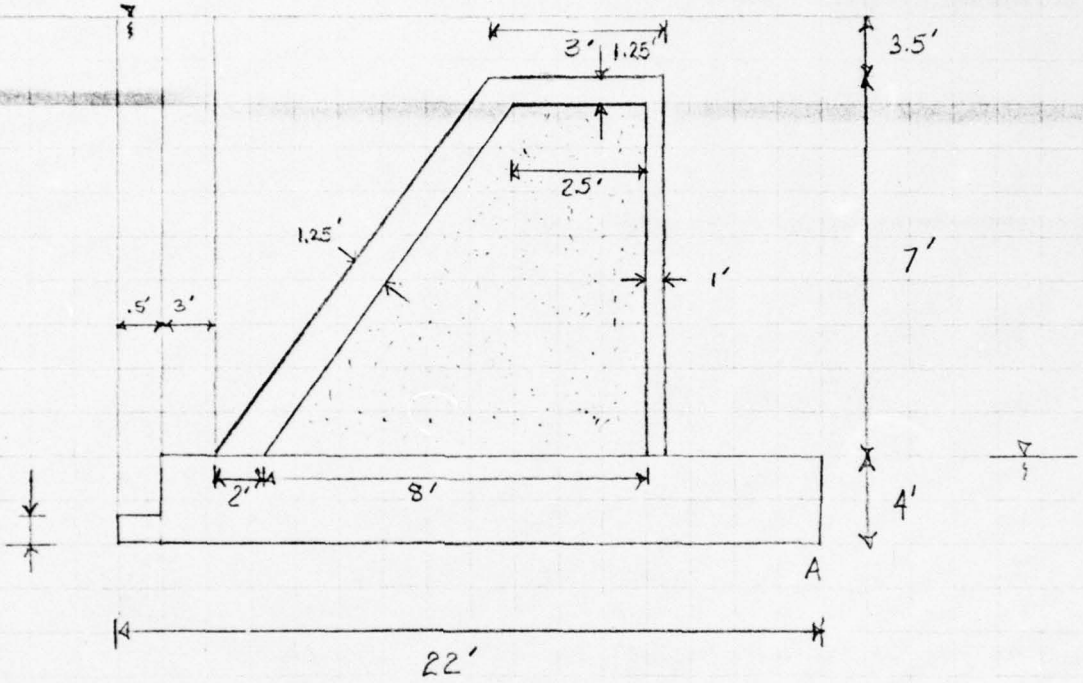
LOUIS BERGER & ASSOCIATES INC.

BLOODGOOD'S DAM

SHEET NO. A 22 OF

PROJECT C-227

ASSUME CAVITY IS FILLED WITH SAND $\gamma = 110^{lb}/ft^3$



CONSIDER ALL FORCES FOR 10' OF DAM

FOOTING: $1 \times .5' \times 10 \times 150^{\#}/ft^3 =$ 750 #

$21.5 \times 4 \times 10 \times 150^{\#}/ft^3 =$ 129 000 #

CONCRETE WALLS AND SLAB: $\left[\frac{1}{2}(7)(3+11) - \frac{1}{2}(5.75)(2.5+8)\right] \times 150 \times 10 =$ 28 218.75 #

BUTTRESS: $\frac{1}{2}(5.75)(2.5+8)(1)(150) =$ 4 528.13 #

SAND FILLER: $\frac{1}{2}(5.75)(2.5+8)(10)(110) =$ 33 206.25 #

bulk unit wgt (some water)

BY. L.C DATE 12/78 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A 23 OF

CHKD. BY DATE BLOODGOOD'S DAM PROJECT C-227

SUBJECT STABILITY COMPUTATIONS

WEIGHT OF WATER:

$.5 \times 13.5 \times 10 \times 62.4\ \#/ft^3$ = 4212

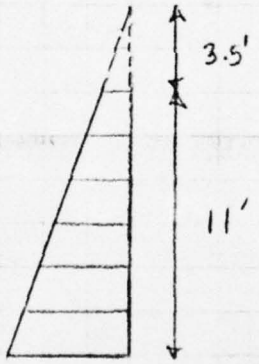
$3 \times 10.5' \times 10 \times 62.4\ \#/ft^3$ = 19656

$\frac{1}{2}(7)(3.5+10.5) \times 10 \times 62.4\ \#/ft^3$ = 30576

SUM OF FORCES 250 kips

HORIZONTAL FORCES

WATER PRESSORE (UPSTREAM)



① $11^2 \times 62.4 \times 10 / 2$ = 37.75 k

② $62.4 \times 3.5 \times 10 \times 11$ = 24 k

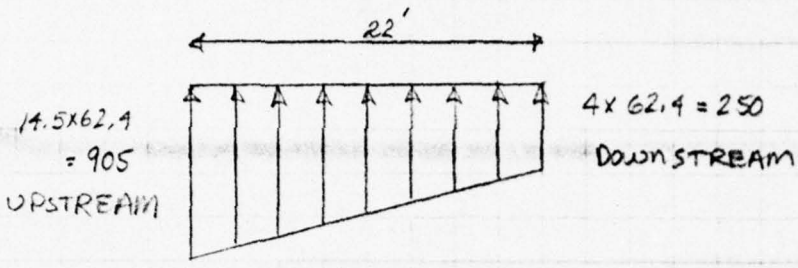
Σ 61.8 k

BY LB DATE 12/78 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A 24 OF

CHKD. BY DATE BLOODGOOD'S DAM PROJECT C-227

SUBJECT STABILITY COMPUTATIONS

UPLIFT PRESSURE



TOTAL UPLIFT = $\frac{1}{2}(22)(905+250) \times 10 =$ 127.05 K

DOWNSTREAM

PASSIVE EARTH PRESSURE

$\phi = 33° \therefore K_p = 3.39$

PASSIVE EARTH PRESSURE = $.6 \times 110^{lb}/_{ft^3} \times 10 \times \frac{4^2}{2} \times 3.39$

= 17.899 k

WATER PRESSURE = $62.4 \times 4^2/2 \times 10 =$ 4.99 k

FACTOR OF SAFETY AGAINST SLIDING ASSUMING COEFF. OF FRICTION = 0.50

$$= \frac{0.5(250 - 127.05)}{(61.8 - 17.899 - 4.99)} = 1.58$$

BY LB DATE

CHKD. BY DATE

SUBJECT STABILITY COMPUTATIONS

LOUIS BERGER & ASSOCIATES INC.

BLOODGOOD'S POND DAM

SHEET NO. A25 OF

PROJECT C-227

MOMENT ABOUT "A"

FOOTING: $750 \times 21.75 = 16312.5$ ft-#

$129000 \times 10.75 = 1386750$ ft-#

CONCRETE WALLS AND SLAB

$$y_1 = 11 - \frac{2(11)^2 + 2(11)(3) - (3)^2}{3(11+3)} = 3.88 \text{ ft}$$

FROM ROARK (YOUNG) PAGE 65

$$y_2 = 8 - \frac{2(8)^2 + 2(8)(2.5) - (2.5)^2}{3(8+2.5)} = 2.865$$

$73500 \times (7.5 + 3.88) - 45281.25 (2.865 + 8.5) = 321808.6$ ft-#

BUTTRESS: $4528.125 (2.865 + 8.5) = 51462.14$ ft-#

SAND FILLER: $33206.25 \times (2.865 + 8.5) = 377389$ ft-#

WATER: $4212 \# \times 21.75 = 91611$ ft-#

$19656 \times 20 = 393120$ ft-#

$\bar{y} = \frac{2}{3} \frac{2(10.5) + 3.5}{10.5 + 3.5} = 4.08$ ft

$30576 \times (4.08 + 10.5) = 445798.1$ ft-#

SUM = 3084 ft-kips

BY L.P. DATE 12/76 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A26 OF

CHKD. BY DATE BLOOD GOOD'S POND DAM PROJECT C-227

SUBJECT STABILITY COMPUTATIONS

HORIZONTAL FORCE (WATER)

$37.75 \times \frac{1}{3} = 138.4$ K

$24 \times \frac{11}{2} = 132$ k

$\Sigma = 270.4$ K-ft

PASSIVE EARTH PRESSURE

$17.899 \times \frac{4}{3} = 23.865$ K-ft

WATER (DOWNSTREAM) $= 4.99 \times \frac{4}{3} = 6.65$ K-ft

ECC. OF RESULTANT

$$\frac{22}{2} - \left(\frac{3084 - 270.4 + 23.865 + 6.65}{250}\right)$$

$= 0.376$ ft TO THE Right of center

SOIL PRESSURE

$$= \frac{250}{22 \times 10}\left(1 + \frac{6 \times 0.376}{22}\right) = 1.25 \text{ kips/ft}^2 \quad \text{MAX}$$

$$= \frac{250}{22 \times 10}\left(1 - \frac{6 \times 0.376}{22}\right) = 1.02 \text{ kip/ft}^2 \quad \text{MIN}$$

BY LP DATE 12/78

CHKD. BY ____ DATE ____

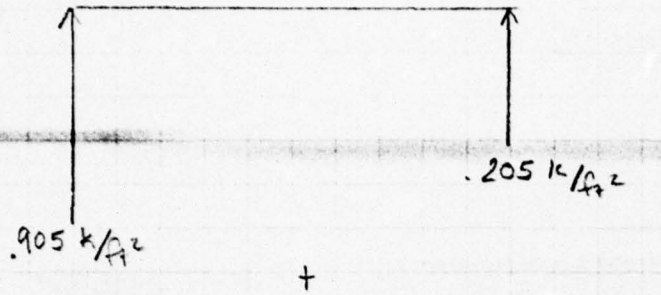
SUBJECT STABILITY COMPUTATIONS

LOUIS BERGER & ASSOCIATES INC.

BLOODGOOD'S POND DAM

SHEET NO. A27 OF ____

PROJECT C-227



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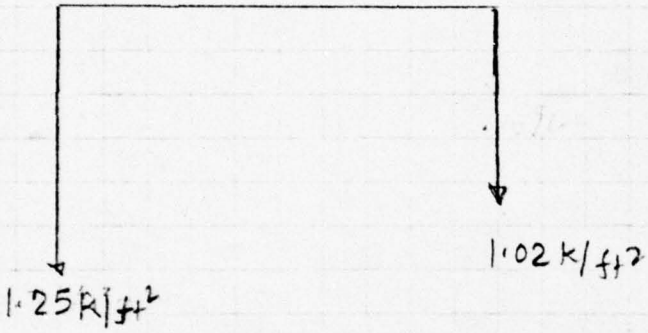

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